FUNt Section E — Errata, Clarifications, and Immediate Test Plan

0) Purpose

This addendum corrects and tightens three areas flagged in peer review: (i) the ε correction usage and sign, (ii) the physical meaning and scale in the complex-k (φ-damped resonator) boundary, and (iii) the precise count of nested φ^7 domains spanning atomic→cosmic frequencies. It also locks a near-term helioseismology test protocol.

1) ε on Levels vs Transitions — Corrected Treatment

Earlier we illustrated ε by applying a φ–scaled correction directly to level magnitudes:

$E_{n,FUNt} = |E_{n,Bohr}| (1 + \varepsilon \varphi^n)$.

This is not the best formulation because spectroscopy measures transitions ΔE, not absolute |E_n|. To avoid sign and normalization ambiguities, we now define a correction on transitions:

$\Delta E_{n+1\to n}^{FUNt} = \Delta E_{n+1\to n}^{Bohr} \cdot (1 + \varepsilon_n)$,

with ε_n expected to be small and, if a φ-overlay exists, to vary log-periodically with n.

For the Lyman-α line (2→1), Bohr agrees with observation at the 10^{-4} level, so the conservative assignment is:

$\varepsilon_1 \approx 0$ (within experimental precision).

This removes the earlier spurious −6.1% and keeps the framework consistent with precision hydrogen data. FUNt's φ-recursion is then tested on residuals across many transitions rather than forced onto any single line.

2) Complex k and Linewidth — What L Really Means

With the boundary $\psi(x+L)=\psi(x)/\varphi$ we obtain $k_n L = n\pi + i \ln \varphi$. The imaginary part implies a finite resonance width. The relevant physical length here is not the Bohr radius; it is the effective optical path of the radiating mode (the radiative cavity length), which for atomic emission is governed by the spontaneous-emission lifetime τ and emission wavelength λ, giving an effective scale $L_{eff} \sim c\,\tau / Q_{geom}$, with Q_geom a geometry factor (≈O(1–10)).

Thus, a practical predictive form is

$\Gamma_n^{FUNt} = \kappa \cdot \Gamma_n^{nat} \cdot \ln \varphi$,

where Γ_n^{nat} is the natural (lifetime-limited) linewidth and κ encodes the cavity/geometric factor derived from L_eff. For Lyman-α ($\Gamma_{nat} \approx 6.27\times10^8$ Hz), the FUNt contribution would be

$\Gamma_{FUNt} \approx \kappa \cdot 6.27\times10^8 \cdot 0.481 \approx 3.02\times10^8\,\kappa$ Hz.

A value $\kappa \lesssim 0.1$ would keep the effect below current line-shape systematics; $\kappa \approx 1$ would be marginally testable. This recasts the linewidth prediction in measurable terms without invoking an unphysical atomic-scale L.

3) Nested ϕ^7 Domains — Corrected Count

Each φ^7 ladder spans $\approx\varphi^7 \approx 29\times$ in frequency ($\sim$10^1.46). To cover 10^{36} across atomic→cosmic scales requires

$m = 36 / (7 \log_{10} \varphi) \approx 25.4.$

We therefore correct the domain count to ≈25 nested/overlapping φ^7 bands.

4) Immediate Test: Solar p-Modes (Helioseismology)

Goal: Detect φ-clustering in ratios of solar p-mode frequencies using public catalogs (GONG or SDO/HMI). Method: Compute all pairwise ratios r=f_i/f_j with 1<r<10 and histogram them; test for peaks at φ^k (k=1..5) above a 3σ threshold.

Analysis sketch (research Python):

1) Load list of p-mode frequencies (μHz → Hz).
2) Compute ratios r=f_i/f_j (i>j), keep 1<r<10.
3) Histogram r on log axis; overlay markers at φ, φ^2, φ^3, φ^4, φ^5.
4) Estimate significance via bootstrapped null (shuffle frequencies; repeat; build CI).

Appendix A — Clean Algebra for ε on Transitions

If one insists on a φ-modulation on levels, consistency demands a separate normalization constant C so that

E_{n,FUNt} = C · φ^n,

and transitions obey ΔE_{n+1→n} = C(φ^{n+1}-φ^n)=Cφ^n(φ−1)=Cφ^{n−1}.

Because $\varphi^2-\varphi=1$, one can set $C=h\nu_0$ with ν_0 equal to the Lyman-α frequency to match 2→1 exactly. However, this then badly mispredicts other hydrogen transitions (e.g., 3→2), so we do not adopt this as a physical hydrogen spectrum. Instead, we treat φ-recursion as a cross-scale resonance overlay tested on residuals and in non-atomic domains (helioseismology, plasmas).

Appendix B — Symbols

φ=1.618034… (golden ratio); Γ_nat (natural linewidth); κ (geometric factor ≈O(0.1–1)); ν_0 (reference frequency); ε_n (small transition residual); L_eff (effective optical path, ~cτ/Q_geom).